UPPER WHITE OAK CREEK WATERSHED INVESTIGATION REPORT

APPALACHIAN WATER RESOURCE SURVEY

Brown and Highland Counties
Ohio

November 1967

UNITED STATES DEPARTMENT OF AGRICULTURE

Economic Research Service Forest Service Soil Conservation Service

FOREWORD

This investigation and report was made under authority of Section 206 of the Appalachian Regional Development Act of 1965. The work was a joint effort of the Economic Research Service, Forest Service, and Soil Conservation Service of the U. S. Department of Agriculture.

Upper White Oak Creek Watershed was selected because of known water and land resource problems preventing or hindering the economic growth and development of the area. The study investigated solutions to these problems and means for full potential development of water and land resources. Selection of this watershed was discussed and approved by the participating agencies in the Appalachian Water resource Survey and the Ohio Department of Natural Resources.

In accordance with Plan of Survey for Development of Water Resources in Appalachia, this report will be reviewed and commented on by agencies in the U. S. Department of Interior; Office of Appalachian Studies, U. S. Army Corps of Engineers; Department of Health, Education, and Welfare; and the Ohio Department of Natural Resources. This review procedure will insure the coordinated and orderly conservation, development, use, and management of water and land resources.

CONTENTS

UPPER WHITE OAK CREEK WATERSHED

Upper White Oak Creek watershed is 80 miles southeast of Columbus - the state capital. The outlet of White Oak Creek into the Ohio River is just west of Higginsport - about 40 miles southeast of Cincinnati.

Headwaters of White Oak Creek originate in west central Highland County - east and a little south of Hillsboro. East Fork of White Oak Creek flows generally southwest to its junction with North Fork of White Oak Creek which flows generally south. From this junction, White Oak Creek flows generally south to the Ohio River. Elevations range from 500 feet at the outlet to 1,150 feet along the northeastern watershed boundary.

Total area of the watershed is 149,050 acres, or about 234 square miles. There are 74,680 acres in Brown County and 33,270 acres in Highland County.

U. S. Route 68 is the main north and south highway. State Routes 32 and 125 are the main east and west highways. Several other highways and improved roads traverse the watershed. U. S. Route 50 runs from east to west just north of the watershed. U. S. Route 52 runs along the Ohio River. A single-track line of the Norfolk and Western Railroad runs from the west through Mt. Orab, Sardinia, Aberystwyth, East Democrat, and generally northeast to Hillsboro.

Lake Grant, with a surface area of 221 acres, is located on Sterling Run. Recreational facilities include an access road, parking area, rest rooms, a small rest camping area, and a boat launching area (for row boats or canoes).

The watershed lies in the Central Feed Grains and Livestock Land Resource Region and the Southern Illinois and Indiana Thin Loess and Till Plain Land Resource Area.

An estimated 90 percent of the soils in the watershed are upland soils. They developed in silt capped Illinoian age glacial till underlain by limestone and calcareous shale bedrock. The silt cap ranges from 12 to 36 inches thick on uneroded areas.

Interstream areas are level to gently sloping (0 to 6 percent). The most common soil series are the somewhat poorly drained Avonburg, poorly drained Clermont and very poorly drained Blanchester. Along streams the slopes increase up to 45 percent. On 2 to 25 percent slopes the moderately drained Rossmoyne and well drained Cincinnati series are most common.

These are deep soils with a pH range of 4.5 to 5.5 in the subsoil. Depths of rooting average 7 feet.

Soils with slopes greater than 25 percent are usually shallow to bedrock and well drained series such as Eden and Fairmount occur most often. These soils are neutral to alkaline. Depth to bedrock is up to 36 inches with rock outcrops common.

The remaining 10 percent of the watershed is made up of terraces and bottom lands. Most of the terraces occur along White Oak Creek. The dominant terrace soils are the well drained Fritchsburg, moderately well drained Sardinia and somewhat poorly drained Arnheim. These are deep soils with that occur on nearly level areas.

Bottom land soils are mostly Genesee and Eel with some Shoals and Ross occurring in small areas. These are neutral to alkaline soils that range from 20 to 48 inches deep.

Present land use in the watershed is approximately as follows: 60 percent cropland, 12 percent pasture, 15 percent woods, and 3 percent other uses. By 1980 land use is expected to be 67 percent cropland, 13 percent pasture, 15 percent woods, and 10 percent other uses.

About 22,493 acres of the watershed are in forest land which is located in small blocks and scattered uniformly throughout the drainage. All of forest land is privately-owned except for a small acreage located within the Lake Grant State Reservation boundary.

Present forest stands consist mainly of hardwoods. Principal types are mixed hardwoods, beech-birch, and oak-hickory.

There are good markets in the area for sawlogs and veneer logs but the market for most small forest products is poor.

According to the U. S. Census of Agriculture the average size farm in 1954 was 135 acres, an increase of 7 percent since 1950. Value of land and buildings for the average farm in 1954 was about $25,800, or $193 per acre. These represent increases of 37 and 24 percent, respectively, since 1950. Value of all farm products sold averaged only $5,500 per farm, but this was an increase of 38 percent in 5 years. Sales of livestock and livestock products represent 63 percent of all farm products sold. About 50 percent of the farm operators work off-the-farm 100 days, or more, per year. Over half of the Brown County labor force is employed in Cincinnati, or its suburbs.

WATERSHED PROBLEMS AND NEEDS

Floodwater Damages

Annual floodwater damage to crops and pasture is estimated to be $37,000. Other agricultural floodwater damage is estimated at $4,500 annually. Approximately 2,530 acres of flood plain are subject to inundation by a 50-year flood. Land use in the flood plain consists of: cropland, 60 percent; pasture, 10 percent; woodland 25 percent, and other, 5 percent.

Annual damages to roads and bridges is about $7,900. Indirect damages include 10 percent of agricultural damages and 15 percent of transportation damages. TABLE 1 lists the estimated average annual damages.

Erosion and Sediment

Erosion is most severe on the slopes between the comparatively flat upland and the flood plain. This contributes to moderate sedimentation damage to crops and pasture on the flood plain.

Improper land use and abuse of the forest land have left it in a generally poor hydrologic condition. This condition contributes to run-off which results in erosion, sediment production, and an increase in the frequency of flooding. Since 12 percent of the watershed is forest land, improvement of the hydrologic condition is an important watershed need.

Agriculture Water Management

Part of the flood plain consists of soils that need tile and/or surface drainage for optimum crop and pasture production. Generally, existing channels provide adequate clearance for tile outlets. Relief of flooding would make additional drainage economically feasible.

There is no existing need for irrigation water. However, if water were available for irrigation, some vegetable production might be achieved. Proximity to metropolitan areas and soils suitable for vegetable production could encourage producers. Water for livestock and general farm use can be provided through present programs.

Non-Agricultural Water Management

The Federal Water Pollution Control Administration reports that there are no known water quality problems, with the exception of some indication of periodic high bacterial concentrations. However, this is localized and can be corrected by proper sewage treatment.

Public Health Service has reported that about 40 percent of the White Oak Creek watershed has very poor ground water supplies, with wells generally yielding less than five gallons per minute. North and east of Sardinia there is a greater abundance of ground water with yields of 5 to 25 gallons per minute. Ground water is also reported to be very hard. Due to the inadequate ground water supply, surface water storage must be utilized to meet future municipal water needs.

Three state-owned state parks, with water-based recreational facilities, are located from 25 to 30 miles from the center of this watershed. These facilities are heavily used. An estimated population of 1½ million lives within a 50-mile radius of the center of this watershed.

TABLE 1

ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE

UPPER WHITE (W. GREEN) WATERSHED, OHIO RIVER BASIN

(Dollars)[1/]

ITEM	DAMAGES
Crop and Pasture	37,000
Transportation	2,900
Other Agriculture	4,300
Subtotal	44,200
Indirect	4,400
Total Damage	48,600

1/ Price Base - Adjusted Normalized.

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PHYSICAL POTENTIAL FOR DEVELOPMENT

The area has an average annual rainfall of 41 inches which yields about 14 inches of runoff. Erosion and drainage problems caused by this rainfall and runoff could physically and economically be reduced to a level in line with good soils and water conservation practices. Better management of the resulting runoff could greatly decrease problems caused by temporary water surpluses and deficiencies.

Located throughout the watershed are many suitable sites for construction of water retention and retardation structures. Installation of the more economical reservoirs could provide protection from excessive flashwater damages. In addition, storage for recreation, municipal water supply, water quality management control, and other beneficial uses could be available at these sites.

The forest land has a high potential to improve hydrologically. This potential can be realized with proper protection and management.

LOCAL INTEREST IN PROJECT DEVELOPMENT

This watershed is in two soil and water conservation districts - 50 percent in Brown and 50 percent in Highland.

Application for a PL-566 Watershed Protection and Flood Prevention Project has not been prepared by local people. There is much concern on the part of many people, especially in the upper part of the watershed, about flashwater damages. This concern has not "jelled" to the extent that positive action has been taken.

If a watershed protection and flood prevention project should be initiated, a legal entity, consistent with the laws of the State of Ohio, could meet the needs for project action.

There are 940 farms entirely or partially within the watershed. There are 335 soil and water conservation district cooperators representing 35 percent participation.

WORKS OF IMPROVEMENT FOR POTENTIAL DEVELOPMENT

Land Treatment Measures

Most of the more sloping wetland cropland needs contour cultivation, grassed waterways, or diversions. Surface drainage is needed on the poorly drained, nearly level soils. About 75 percent of the permanent pasture needs treatment with lime and fertilizers 70 percent of this acreage also needs seeding to establish desirable forage vegetation.

Fire is not a serious problem in the forest land, but continued protection is basic and essential to derive the maximum benefits from all watershed protective measures. Tree planting is needed to establish an adequate protective cover on some small areas of abandoned agricultural lands. Forest land is grazed in some areas of the watershed. Protection of this land from domestic livestock is needed.

Logging roads and skid trails should be properly located and maintained for erosion control. Hydrologic stand improvement practices are needed on a large part of the forest land to establish and develop desirable species and to maintain favorable spacing and stand conditions.

Structural Measures

Seven potential floodwater retarding structure sites were examined. One was discarded because its valley was highly developed agriculturally. The remaining six sites are suitable for development within one or both of the development levels discussed herein.

To satisfy the identified needs, all six structures are needed for floodwater retardation. One of these, structure Site No. 5, is especially suited for recreational development. Structure Site Nos. 1 and 5 each control approximately 22 square miles. Each is located at the head of one of the two branches into which the main stem splits. Immediately below Structure Site No. 1 is a highly developed agricultural reach which would receive nearly a hundred percent protection. Further downstream Structure Site Nos. 2, 3, and 4 are needed to supplement the effectiveness of the head structure. These lower reaches on the East Fork of White Oak Creek are predominantly intensive agricultural.

On the North Fork of White Oak Creek, and below Structure Site No. 5, the reaches are utilized mainly for agricultural purposes, but with somewhat less intensity than on East Fork. Besides providing agricultural benefits, the structure would eliminate residential damages at Oxford up to a 50-year storm. Structure Site No. 6, located on a tributary of the lower end of this reach, would serve mainly to increase control on the main stem - below the junction of North and East Forks. Reach No. 10, which is the first one below the junction, would receive a damage reduction of 80 percent. Both this intensive agricultural reach the stream and steepens with the result that floodwater passes without inflicting appreciable damages. Therefore benefits are right through reach No. 11 and below. These reaches generally are of minimal agricultural importance and lack other economic development.

Recreational development in the watershed could be centered around a permanent pool at Structure Site No. 5. Pool size was limited to 340 acres by the abutment heights. Land adjacent to this pool is relatively flat. Except for scattered blocks of forest lands, the surrounding land is relatively open. Although used for agriculture, yields are somewhat low due largely to drainage problems. Wooded areas could be expanded

of suitable location to provide some desirable environment for camping and picnicking. In addition to access roads and parking facilities, other basic facilities would include construction of camp sites, boat docks and ramps, benches, picnic areas, and sanitary facilities. Water quality seems adequate to support such development.

Development of the recreational facilities would enhance the areas surrounding the lake. Day use would largely be drawn from local communities, although considerable usage could be expected to show from the metropolitan area of Cincinnati which is within a 50 mile radius. Overnight users could include not only campers from southwest Ohio, but from more distant areas - especially if Appalachian Highway (Corridor D) is constructed. This highway would pass through the watershed and within ten miles of the lake. Peak usage by an estimated 7,000 visitors per day could be expected.

The level of development designated as maximum potential within this report includes the six structure sites previously mentioned. Structure Site Nos. 1 and 5 were included in this level without change since availability of additional storage was quite limited. The remaining structure sites Nos. 2, 3, 4, and 6 were expanded to include an additional 6,480 acre-feet of beneficial storage. This storage could be used for municipal water supply, recreation, water management control, or other beneficial use.

Population projections for Appalachian Economic Sub-Region 9 which embraces this watershed show increases as follows: to 1990-95 percent; to 2000-05 percent; and to 2020-110 percent. It is unlikely that the population increase in Brown and Highland Counties would exceed 50 percent of the respective projections listed above.

The information given below was compiled from yield data curves, based on study and analysis of runoff data on Ohio Brush Creek at Hillsboro, Ohio.

Str. Site Nos.	Purpose	Percent Chance* of Shortage	Additional Supply Provided (year 2020) Location	cfs	MGD
2, 3, 4, 6	Addl. Supply	10	W.S. Outlet	26	17

* Usually used in the Northeast.

TABLE 11

STRUCTURE DATA

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN

Site No.	Drainage Area (Sq.Mi.)	Est. Height of Dam (Feet)	Est.Vol. of Fill (Cu.Yd.)	PRINCIPAL SPILLWAY Type	Rainfall Rate (CSM)	EMERGENCY SPILLWAY Type	% Chance of Use	Max. Surface Type Ex. Spill. Level (Acres)
1	22.0	38 (38)	125,000 (125,000)	Reinforced Concrete Conduit	15	Veg.	2	330 (380)
2	5.1	35 (45)	45,000 (87,000)	" " "	15	Veg.	2	115 (155)
3	5.5	38 (37)	,000 (105,000)	" " "	15	Veg.	2	130 (230)
4	5.5	34 (42)	56,000 (105,000)	" " "	15	Veg.	2	100 (215)
5	22.6	45 (45)	208,000 (308,000)	" " "	13	Veg.	2	800 (800)
6	11.6	40 (45)	80,000 (105,000)	" " "	13	Veg.	2	220 (390)
TOTAL	72.1		589,000 (735,000)					1,745 (2,240)

NOTE: Figures not in parentheses indicate the development of the site for identified needs.
Figures enclosed in parentheses reflect the development of the site to its full potential.

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TABLE III

RESERVOIR STORAGE CAPACITY

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN

Site No.	Drainage Area	Storage Capacity Evaluated										Additional Storage Capacity Available
		Flood Prevention						Recreation		Total		
		Sediment		Detention		Subtotal						
	(Sq.Mi.)	(Ac.Ft.)	(In.)	(Ac.Ft.)	(In.)	(Ac.Ft.)	(In.)	(Ac.Ft.)	(In.)	(Ac.Ft.)	(In.)	(Ac.Ft.)
1	22.0	1,400	1.2	3,180	2.7	4,580	3.9	-	-	4,580	3.9	-
2	5.1	325	1.2	730	2.7	1,055	3.9	-	-	1,055	3.9	1,900
3	5.5	350	1.2	735	2.5	1,085	3.7	-	-	1,085	3.7	1,110
4	6.9	355	1.2	735	2.5	1,090	3.7	-	-	1,090	3.7	1,310
5	22.6	1,670	1.4	3,320	2.7	4,990	3.9	5,380 1/	4.5	10,370	8.6	-
6	11.6	740	1.2	1,660	2.7	2,400	3.9	-	-	2,400	3.9	2,090
TOTAL	73.1	4,840		10,340		15,180		5,380		20,580		5,490

1/ Surface Area of Recreation Pool = 580 acres.

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NATURE AND ESTIMATE OF COSTS OF IMPROVEMENT

The basis for estimating the costs of potential structural improvements was 7½ minute USGS Quadrangle Sheets from which stage storage curves were developed. Crest of the emergency spillway was placed so as to be used on an average of once in a hundred years. This elevation was obtained by an approximate routing method using curves relating the volume retarded to the total volume of inflow for a given storm type and average release rate. By imposing the restrictions that the conduit must be 24 inches or greater in diameter, and that 90 percent of the retarded water discharged in 10 days after reaching its crest, average release rates were determined. Design and freeboard elevations were determined by a modification of the rapid routing procedure developed by the SCS Regional Technical Service Center at Upper Darby, Pennsylvania. Estimated cost of each potential structure was based on a unit cost per cubic yard of earthfill taken from the 1966 unit cost curve. The curve was plotted from the total bids of actual contracts awarded for watershed structures in a similar land resource area.

Installation service cost was in accordance with cost records from the Soil Conservation Service files for similar structures built in the past five years.

Easement costs were based on local property values and from observations in the field and from elevations taken on the USGS Quadrangle sheets. For the level of development to meet identified needs, $484,000 was included for land easements and $130,000 for buildings.

Operation and maintenance costs for all six structures were estimated to be $1,700 annually.

An amount of $500,000 was included for basic facility construction at Structure Site No. 5. Additional land acquisition for camp, picnic, and other recreational uses was placed at $600,000. Operation and maintenance estimate for recreational facilities was $30,000. These estimates were established after consideration of quantities and costs for similar recreational developments.

Cost of administering contracts was taken to be 3 percent of construction costs.

TABLE IV

ESTIMATED STRUCTURAL COST

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN

(Level of Development to Meet Identified Needs)

Item	Unit	Amount Planned	Estimated Total Cost (Dollars) 1/
STRUCTURAL MEASURES:			
Construction			
Floodwater Retarding Str.	No.	5	452,000
Multiple Purpose Structures:			
FP & Recreation	No.	1	728,000
Subtotal Construction			1,220,000
Installation Services			384,000
Land Easements & R/W.			1,141,000
Administration of Contracts			57,000
TOTAL STRUCTURAL MEASURES	No.	6	2,702,000

1/ Price Base - 1966.

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DISTRIBUTION OF STRUCTURAL COST

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN

(Level of Development to Meet Identified Needs)

Structural Measures	Str. No.	Installation Cost (Dollars) 1/				
		Construction	Installation Services	Land Easements and R. W.	Admin. of Contracts	Interest Cost
Single Purpose Structures:						
Flood Prevention	1	144,000	43,000	146,000	4,000	[illegible]
Flood Prevention	2	72,000	24,000	46,000	2,000	[illegible]
Flood Prevention	3	98,000	33,000	101,000	5,000	250 [illegible]
Flood Prevention	4	78,000	25,000	60,000	3,000	167 [illegible]
Flood Prevention	6	100,000	33,000	119,000	3,000	228 [illegible]
Multiple Purpose Structures:						
F. P. & Recreation	5	222,000	70,000	357,000	7,000	574 [illegible]
Basic Facilities		500,000	150,000	400,000	15,000	1,000 [illegible]
TOTAL		1,220,000	384,000	1,181,000	37,000	2,702 [illegible]

1/ Price Base - 1966.

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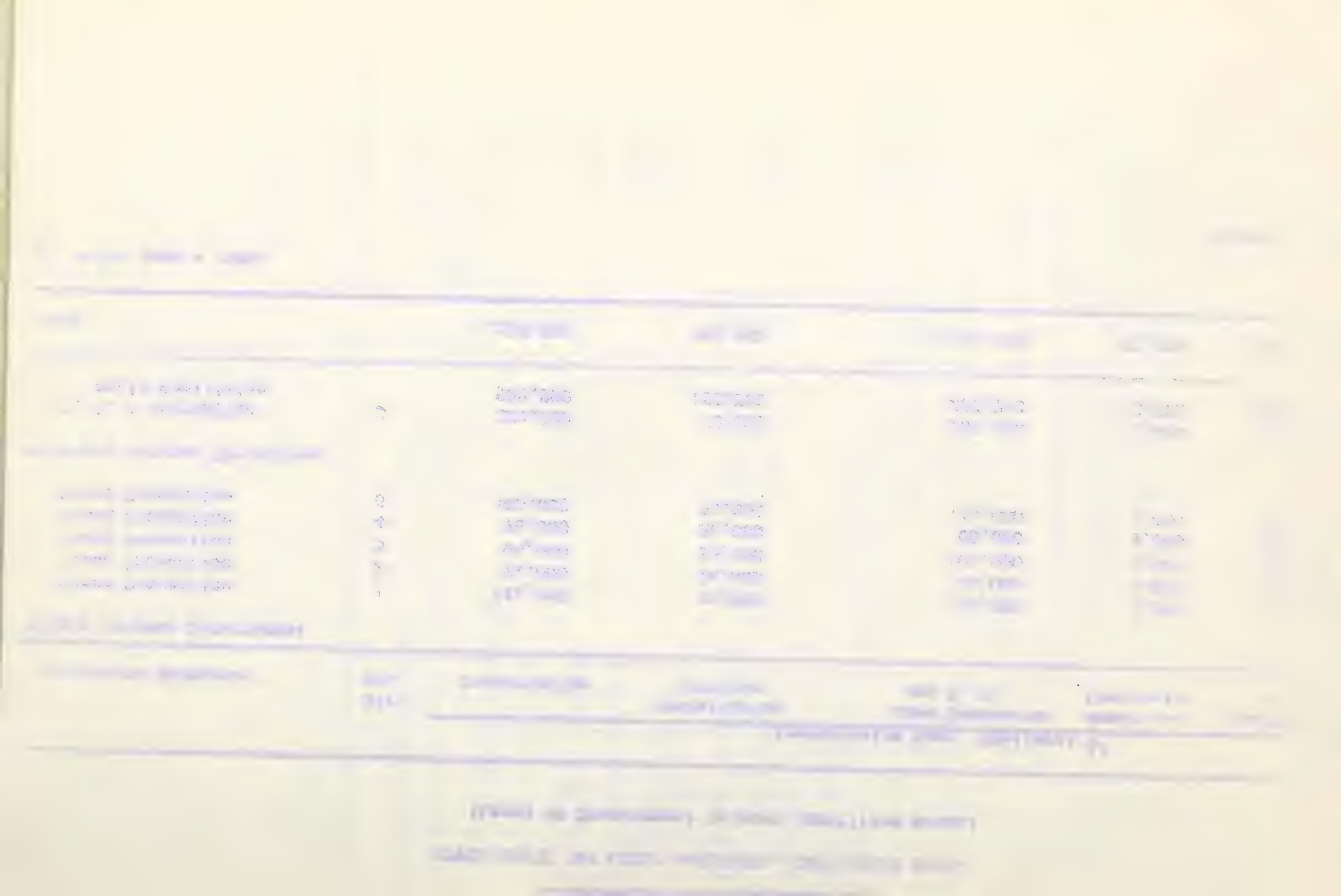

TABLE V-A

DISTRIBUTION OF STRUCTURAL COST

UPPER WHITEOAK CREEK WATERSHED, OHIO RIVER BASIN

(Full Development Potential)

Structural Measures	Str. No.	Installation Cost (Dollars) 1/ Construction	Installation Services	Land Easements and R. W.	Admin. of Contracts	Installed Cost
Single Purpose Structures:						
Flood Prevention	1	144,000	[illegible]	146,000	4,000	[illegible]
Multiple Purpose Structures:						
F. P. & Beneficial	2	105,000	74,000	121,000	3,000	[illegible]
F. P. & Beneficial	3	121,000	40,000	165,000	4,000	330,000
F. P. & Beneficial	4	126,000	42,000	117,000	4,000	299,000
F. P. & Recreation	5	226,000	70,000	267,000	7,000	574,000
Basic Facilities		500,000	150,000	400,000	15,000	1,065,000
F. P. & Beneficial	6	120,000	42,000	210,000	4,000	366,000
TOTAL		1,350,000	425,000	1,426,000	41,000	3,241,000

1/ Price Base - 1966.

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TABLE VI

COST ALLOCATION

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN

(Level of Development to Meet Identified Needs)

(Dollars)1/

Item	Flood Prevention	Recreation	Total
Single Purpose:			
Structure No. 1	342,000		342,000
Structure No. 2	146,000		146,000
Structure No. 3	235,000		235,000
Structure No. 4	167,000		167,000
Structure No. 6	255,000		255,000
Multiple Purpose:			
Structure No. 5	217,000	355,000	572,000
Basic Facilities	--	1,065,000	1,065,000
TOTAL	1,362,000	1,420,000	2,782,000

1/ Price Base - 1966.

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TABLE VI-A

CASE ALLOCATION

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN

(Full Development Potential)

(Dollars) 1/

Item	Flood Prevention	Recreation	Additional Beneficial Storage Available	Total
Single Purpose:				
Structure No. 1	342,000	-	-	342,000
Multiple Purpose:				
Structure No. 2	74,000	-	189,000	263,000
Structure No. 3	152,000	-	198,000	350,000
Structure No. 4	101,000	-	188,000	289,000
Structure No. 5	217,000	355,000	-	572,000
Basic Facilities	-	1,065,000	-	1,065,000
Structure No. 6	168,000	-	214,000	382,000
TOTAL	1,054,000	1,420,000	789,000	3,263,000

1/ Price Base - 1965.

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EFFECTS AND ECONOMIC EVALUATION OF POTENTIAL DEVELOPMENT

Water Resource Development

Average annual flood reduction benefits were estimated to be $32,200 from structural measures and $1,470 from land treatment. Land enhancement to agriculture, including more intensive use and some changed land use, was estimated to provide benefits of $10,900.

A fully developed recreation facility was figured for Structure Site No. 5. Average annual use was estimated at 27,000 visitor-days. A benefit rate of $1.50 per visitor-day was assigned. After discounting, the average annual benefit would be $123,400.

The development of additional water storage facilities will increase recreational use of the surrounding forest land. This will have an impact on the management and protection of the area.

Direct redevelopment benefits were used in the evaluation and were estimated at $22,000. This includes 10 percent of construction costs and 90 percent of operation and maintenance cost (both are on an annual equivalent basis).

Local secondary benefits would be $18,500 annually.

The ratio of average annual benefits to average annual cost, for all works of improvement, would be 1.8:1. The benefit-cost ratio excluding local secondary benefits would be 1.3:1.

Summary of benefits, costs, and comparisons are listed in the attached TABLES VII and VIII.

With the level of development to meet the identified needs, most of the land in the agricultural reach Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 has between a two and three-year growing season level of protection.

For existing conditions, the 2-year flood would inundate 1,200 acres, the 5-year flood 3,160 acres, and the 50-year flood 5,330 acres in the agricultural reaches listed above. With the level of development described in this report, the acreage flooded would be 380, 1,100, and 2,440 respectively for the 2-year, 5-year, and 50-year floods.

Total Area Development

Potential water resource development could provide 2-to-3 year growing season protection to 500 acres of flood plain land.

Total flood prevention benefits are estimated to be $32,200 annually. Benefits for more intensive land use of agricultural lands amounts to $10,900. This development could provide a 500-acre recreational lake in addition to basic facilities. Total annual visitor-days are estimated to be 87,000 with a benefit of $123,400. In addition, there are regional expansion benefits for recreation of $152,700 from the increased business activity created by the money spent within the area by those people from outside the area.

Redevelopment benefits are estimated at $20,200 and reflect the wages and salaries of unemployed and underemployed people used in construction, operation, and maintenance of the water resource development.

More intensive land use of agricultural land will provide agricultural enhancement benefits of $11,100 annually.

Average annual benefits and costs for the total area development amount to $196,600 and $112,600, respectively. The benefit-cost ratio is 1.7:1. Summaries of benefits and costs are listed in TABLE VIII-A.

The benefit-cost ratio is based on the total national benefits and total area development costs. This does not include local secondary or regional transfer benefits.

Total regional benefits amount to $266,700 and include user, redevelopment, national expansion, and inter- and intra-regional transfer benefits. There could be additional national benefits if a need arises in the future for the 6,400 acre-feet of beneficial storage. Methodology used in determining expansion benefits was the USDA evaluation procedures for upstream watersheds developed for this study.

TABLE VIII

ANNUAL COST

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN 1/

(Dollars)

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
1	91,100	21,700 3/	112,800 4/

1/ Price Base--1966 for installation costs and adjusted normalized for operations and maintenance, and other economic costs.

2/ 2-1/8% -- 100 year amortization period.

3/ Includes $20,000 for annual operation and maintenance of recreational facilities.

4/ Flood Prevention cost is $46,000.

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TABLE XIII-1

COMPARISON OF BENEFIT AND COST FOR STRUCTURAL MEASURES

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN

(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS: Flood Prevention Damage Reduction	Flood Prevention More Intensive Use (Agr. Lands)	Recreation	Redevelopment	Local Secondary	Total	Average Annual Costs	Benefit Cost Ratio
1	32,200	10,900	122,400	22,000	18,900	206,400	112,800	1.8:1
TOTAL	32,200 2/	10,900	122,400	22,000	18,900	206,400	112,800	1.8:1

1/ Price Base – Adjusted Normalized for benefits, operation and maintenance and other economic costs; 1966 for installation cost.

2/ In addition it is estimated that land treatment measures will provide flood damage reduction benefits of $1,470 annually.

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TABLE VIII-4
COMPARISON OF BENEFITS AND COSTS FOR
STRUCTURAL MEASURES INCLUDING
AREA DEVELOPMENT

UPPER WHITE OAK CREEK WATERSHED, OHIO RIVER BASIN

Collbran 1/

Category and Class of Benefits	National Account Only	Regional Account Only	Both National and Regional Accounts	Total National Benefits	Total Regional Benefits
User Benefits:					
Flood Prevention 2/			[illegible],200	32,200	32,200
Land Enhancement			[illegible],000	10,000	10,900
Recreation			[illegible],400	[illegible],400	[illegible],400
Subtotal			[illegible],500	165,500	165,500
Redevelopment		17,200	20,800	20,200	37,400
User and Redevelopment		17,200	185,700	185,700	202,400
Expansion Benefits:					
Development		0	0	0	0
Recreation		52,700			52,700
Agricultural Enhancement			11,100	11,100	11,100
Subtotal		52,700	11,100	11,100	63,800
Total Benefits		69,900	196,800	196,800	266,700

	Annual Cost
Water Resource Plan	112,800
Area Development Plan	0
Total Annual Cost	112,800

1/ Price Base - Adjustments annualized for benefits and OMM [illegible] for installation cost for water resource plan.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $ 1,470 annually.

ALTERNATE OR ADDITIONAL POSSIBILITIES

1. This report was prepared with the idea of complementing the structural measures proposed by the Corps of Army Engineers. Only those floodwater prevention benefits were claimed which would remain upon completion of the tentatively proposed Corps dam. The tentatively proposed structure would be located at approximately the foot of reach No. 12. The maximum flood control level would inundate reaches 11 and 12. Benefits from these reaches were not included in this report, but could be claimed if plans for the large structure should be abandoned. In addition, there was no specific allocation of water made to meet municipal water supply needs. It was assumed that the Corps structure would provide the necessary storage to satisfy the demand.

2. Although recreational development was included in this report, these costs and benefits could be removed. A favorable benefit-cost ratio, for flood prevention only, would remain.

3. Optimum utilization of retardation structures as a method in reducing floodwater damage was attempted in this study. Additional reductions could be obtained through localized channel modifications.

ALTERNATE OR ADDITIONAL RECREATIONAL USE

1. This report was prepared with the idea of complementing the structural measures proposed by the Corps of Army Engineers. Only those floodwater prevention benefits were claimed which would remain upon completion of the tentatively proposed Corps dam. The tentatively proposed structure would be located at approximately the foot of reach No. 12. The maximum flood control level would inundate reaches 11 and 12. Benefits from these reaches were not included in this report, but could be claimed if plans for the large structure should be abandoned. In addition, there was no specific allocation of water made to meet municipal water supply needs. It was assumed that the Corps structure would provide the necessary storage to satisfy the demand.

2. Although recreational development was included in this report, these costs and benefits could be removed. A favorable benefit-cost ratio, for flood prevention only, would remain.

3. Optimum utilization of retardation structures as a method in reducing floodwater damage was attempted in this study. Additional reductions could be obtained through localized channel modifications.